Remarks

Initially, Applicants thank Examiner Ciric for the time afforded their undersigned representative on January 5, 2007, in connection with the rejection stated in the December 14, 2006 Office Action. During this interview, claims 9-16 were discussed, and in particular, the 35 U.S.C. §112, second paragraph, rejection thereof stated in the Office Action. During the interview, the Examiner explained that the rejection of December 14, 2006, was not meant to broaden the initially issued 35 U.S.C. §112, second paragraph, rejection of claims 9-16 stated in the second paragraph of page 6 of the Office Action of June 27, 2006.

The Examiner indicated that Applicants were requested to address the rejection with respect to independent claim 9, as well as dependent claims 11 &13 as set forth in the second paragraph of page 6 of the Office Action of June 27, 2006. In particular, an explanation of the "means for retaining isolation of the at least one coolant loop from coolant flow through the cooling system upon detection of a drop in coolant pressure in the at least one coolant loop" as recited in claim 9 was requested, as well as an explanation of the "means for waiting a defined interval" as recited in claim 11, and the "means for sending a signal to shut off power to the associate electronic subsystem when a leaking coolant loop is detected" as recited in claim 13.

The remarks below are a *bona fide* attempt by Applicants to address in greater detail these noted rejections to claim 9, 11, & 13 and all claims depending therefrom. During the telephone interview, the Examiner Ciric indicated that should any issue remain unresolved, Applicants would be afforded a further opportunity to address the issue via a further reply. Notwithstanding this, Applicants respectfully submit that all rejections are fully addressed in their response filed September 26, 2006, as supplemented by the remarks set forth below. As such, allowance of all claims is respectfully requested.

FIG. 4 of the present application depicts one partial embodiment of a coolant distribution unit having an integrated heat exchanger/expansion tank 400 which employs coolant monitoring in accordance with an aspect of the present invention. (See paragraph [0037] of the specification.) Control system microcode 440 monitors and records at regular intervals pressure in the expansion tank. By taking successive pressure measurements and dividing by the time between measurements, it is possible to determine a rate of change of water volume in the tank.

The control system microcode can be programmed to compare the rate of volume change against preset criteria to determine if a serious leak is present and initiate appropriate action where needed. (See paragraph [0038] of the specification.)

FIG. 6 is one flowchart example of processing implemented by the control system microcode in accordance with an aspect of the present invention. (See paragraph [0041], lines 1 & 2 of the specification.) This processing includes determining whether the volume measurement at time T1 is larger than the volume measurement at time T2. (See specification paragraph [0043] line 4.) If so, then leak isolation protocol is automatically initiated 690. (See paragraph [0043], line 5 of the specification.

One embodiment of an automatic leak isolation protocol is described in the application with reference to FIGS. 7-9. The structure of FIG. 7 is described in paragraphs [0044] – [0046] of the specification which are repeated below for convenience:

> ***[0044]*** *One embodiment of an automatic leak isolation protocol is described below with reference to FIGs. 7–9. This protocol assumes the existence of a coolant distribution unit, generally denoted 700 in FIG. 7, which includes multiple coolant loops, one of which is depicted in FIG. 7 as supplying coolant to an electronics rack 710. Electronics rack 710 couples to the coolant distribution unit 700 through multiple connect/disconnect couplings 715. Although shown as having five coolant loop supply lines out of a supply manifold 720, the number of coolant loops could equal, for example, the number of electronics racks in the computing environment.*
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> ***[0045]*** *In accordance with one embodiment of the leak isolation protocol described herein, a technique is provided for identifying a coolant loop having a leak and then isolating that coolant loop to minimize loss of coolant, thereby allowing the remaining electronics racks to continue operating normally. As shown in FIG. 7, a pressure transducer "Ps" is mounted on the supply manifold 720, and solenoid actuated valves 725, 735 on the supply and return, respectively, are provided for each coolant loop. A pressure transducer "Pr" is also disposed at the return for each coolant loop.*
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> ***[0046]*** *Operationally, one method and sequence of operation for the leak isolation protocol would be described as follows:*

1. *Hydrostatic pressure within the expansion tank (see FIG. 5A) of the coolant distribution unit is monitored and logged by control system microcode (see FIG. 4). This data is used by the microcode to calculate a rate of volume change of coolant within the expansion tank as described above.*

2. *If the rate of volume change of coolant indicates the presence of a leak in the cooling system, then the leak isolation protocol is initiated by the microcode to identify and isolate any leaking coolant loop of the system.*

3. *Under microcode control, the solenoid operated shut-off valves at the return and supply manifolds at a first coolant loop are energized and closed in that order.*

4. *The return pressure "Pr" is monitored for a short time (e.g., 5 – 10 seconds). If a leak is present, the return pressure will decay below supply pressure "Ps" as shown in FIG. 8. Responsive to this decay, the microcode initiates a power down sequence for the effected electronics rack. Note that pressure within a leaking coolant loop will decay rapidly even for relatively small leak rates.*

5. *If a leak is not present in the coolant loop, then the return pressure "Pr" will hold steady at a level equal to the supply pressure "Ps", and the microcode will energize and open the solenoid valves 725, 735 for the coolant loop returning normal coolant flow through the loop.*

6. *The above test sequence 3. – 5. is repeated for each successive coolant loop in the system to identify and isolate any leaking coolant loop. Once identified, the solenoid valves in a leaking coolant loop are left closed to isolate the coolant loop, and a signal is sent to power down the effected electronics rack.*

A similar sequence and procedure to that discussed above may be executed during normal operation at prescribed time intervals to test and ensure that the leak detection and isolation system is operative.

As noted in the above discussion, under microcode control, the solenoid-operated shut off valves at the return and supply manifolds of a first coolant loop are energized and closed in that order. The return pressure "Pr" is monitored for a short time, and if the leak is present, then the return pressure will decay below supply pressure "Pr" as shown in FIG. 8. Responsive to this decay, the microcode initiates a power down sequence for the effected electronics rack. The sequence is repeated for each successive coolant loop in the system to identify and isolate any leaking coolant loop. Once identified, the solenoid valves in a leaking coolant loop are left closed to isolate the coolant loop and a signal is sent to power down the effected power rack.

Applicants respectfully submit that the "means for retaining isolation of the at least one coolant loop" recited in claim 9 is clear to one skilled in the art from the above discussion. The means includes the control system microcode and the solenoid valves 725, 735 of the at least one coolant loop having a detected drop in coolant pressure.

Additionally, FIG. 9 is a flowchart example of a leak identification and isolation protocol which can be implemented by the control system microcode. (See paragraph [0047] lines 1 & 2 of the specification.) This protocol is responsive to a leak detected indication which may result from processing such as depicted in FIG. 6. (See paragraph [0047] lines 3 & 4 of the specification.) As amended in the Response to Office Action filed September 26, 2006, paragraph [0048] of the Specification indicates:

> ***[0048]*** *Processing then determines whether the value of the supply side pressure Ps_i less the value of the return side pressure Pr_i for this coolant loop is greater than a defined decay value "S" 955. If "yes", then processing retains isolation of loop i and sends a signal to power down the associated electronics rack i which is cooled by the leaking coolant loop i 960. The found leak for coolant loop i is logged 965 and the leak counter is incremented by one to signal the identification of one leaking coolant loop 970. Processing then determines whether all coolant loops have been tested 975. If "no", then the process repeats for the next coolant loop of the system by incrementing the loop counter by one 920.*

In paragraph [0048], it is indicated in lines 3 & 4 that processing *retains isolation of loop i if processing determines that the value of the supply side pressure Ps_i less the value of the return side pressure Pr_i for this coolant loop is greater than a defined decay value "S".* This retaining isolation of loop i by the microcode maintaining closed the solenoid valves for loop i is one example of the "means for retaining isolation of the at least one coolant loop" recited in claim 9.

Additionally, paragraph [0048] lines 4 & 5 teach that the processing *sends a signal to power down the associated electronic rack i which is cooled by the leaking coolant loop i 960.* This sending of a signal to power down the associated electronics rack i by the processing (i.e. by the control system microcode) is one example of the recited "means for sending a signal to shut off power to the associated electronic subsystem when a leaking coolant loop is detected" recited in dependent claim 13.

One example of the *means for waiting a defined interval* recited in dependent claim 11 is taught in the process of FIG. 9 at block 945, and in paragraph [0047] line 10 of the specification. In particular, the processing of dependent claim 11 recites that the means for automatically checking includes for each coolant loop of the multiple coolant loops, means for *closing the return side solenoid valve* Sr_i *930 and reading a value of supply pressure* Ps_i *935, then closing the supply side solenoid valve* Ss_i *940, and waiting an interval of time t seconds 945, after which the value of the return pressure is read* Pr_i *950.* (See paragraph [0047], lines 7-10 of the specification.) This processing logic of the control system microcode is one example of the means for waiting a defined interval between closing of the second valve and reading of the second pressure value of coolant in the coolant loop.

In view of the above teachings, Applicants respectfully submit that the means plus function limitations of claims 9, 11 & 13 are well supported by the application as filed and clear to one of ordinary skill in the art. As such, Applicants request reconsideration and withdrawal of the 35 U.S.C. §112, second paragraph, rejection to claims 9-16.

Applicants believe that the above-noted discussion fully addresses the Examiners rejection set forth in the Office Actions of June 27, 2006 and December 14, 2006, as explained by the Examiner in the telephone interview of January 5, 2007. *However, should any issue remain unresolved, Applicants undersigned representative requests that the Examiner telephone Applicants undersigned representative in the hope of furthering prosecution of this application.*

Respectfully submitted,

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